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Real-Time Multi-Class Face Recognition Using Deep Embedding and a Novel Lightweight Deep Learning Model

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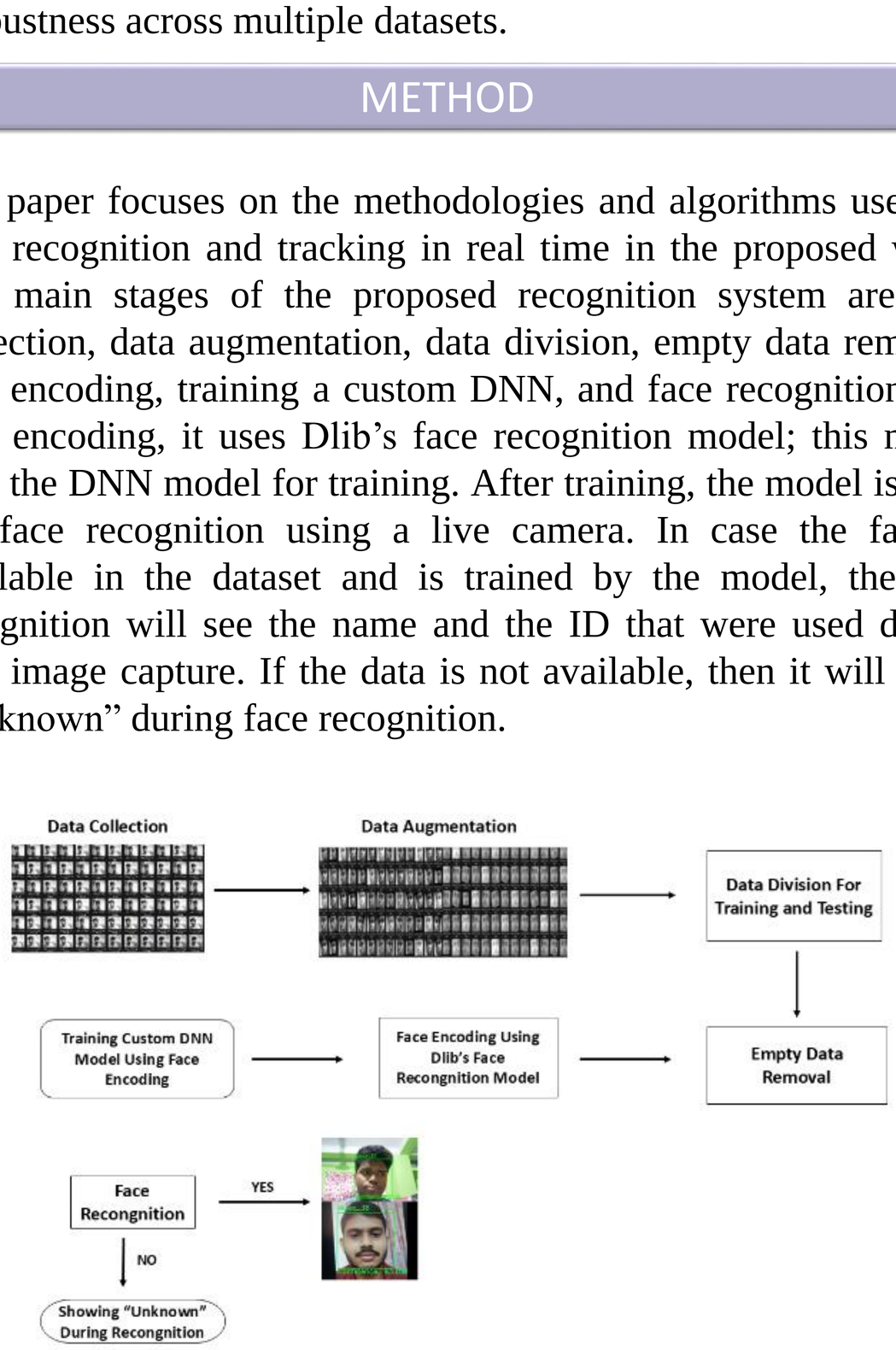
INTRODUCTION & AIM

Face recognition technology has been developing at a fast pace, owing to the deep learning algorithms. In this approach, a personalized deep neural network (DNN) model is trained on two datasets. In this paper, we further specifically consider video as our training/testing data, under the framework of a video-based face recognition system to effectively and accurately identify any certain individual in database. The comparison with Convolutional Neural Networks (CNNs) is also presented, as well as the traditional methods Eigenface, Fisherface and Local Binary Patterns Histogram (LBPH), classical deep learning approaches including Support Vector Machines (SVM) and Multilayer Perceptron (MLP). The results showed that state of the art accuracy of 94% was achieved on an online dataset with 5,817 labels and 99.37% on a self-collected smaller dataset with 68 labels and 1,564 augmented samples. These results serve to demonstrate that the custom DNN model is a viable solution for real-world facial recognition systems, with high accuracy and robustness across multiple datasets.

METHOD

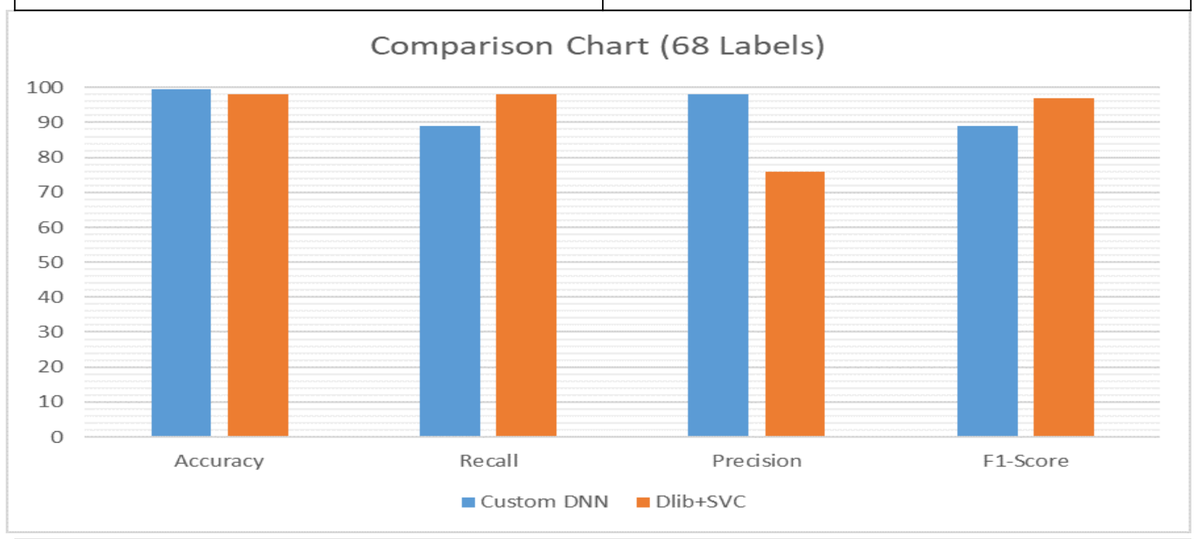
The paper focuses on the methodologies and algorithms used for face recognition and tracking in real time in the proposed work. The main stages of the proposed recognition system are data collection, data augmentation, data division, empty data removal, face encoding, training a custom DNN, and face recognition. For face encoding, it uses Dlib's face recognition model; this model uses the DNN model for training. After training, the model is used for face recognition using a live camera. In case the face is available in the dataset and is trained by the model, the face recognition will see the name and the ID that were used during face image capture. If the data is not available, then it will show "Unknown" during face recognition.

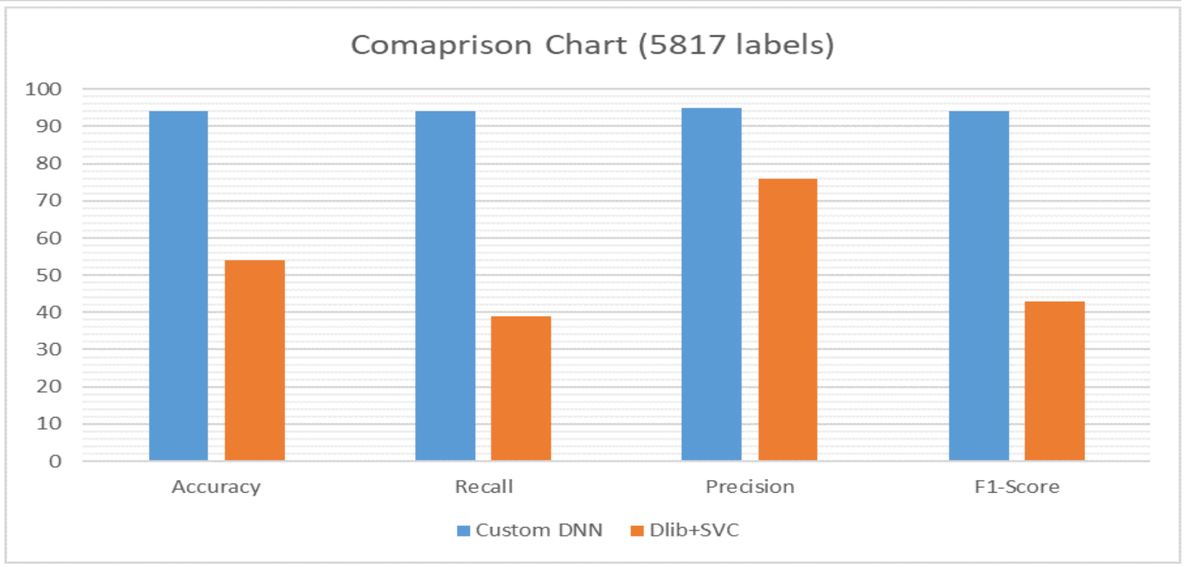


RESULTS & DISCUSSION

With 68 labels dataset the model has received 99.37% accuracy and with 5817 labels dataset it has received 94% accuracy. It is clear from all of these comparisons that deep learning techniques in particular, DNNs consistently perform better in terms of accuracy than conventional facial recognition algorithms like CNN, Eigenface, Fisherface, and LBPH.

Algorithm	**Accuracy**
Eigenface	*15.09%*
Fisherface	*36.4%*
LBPH	*86.47%*
SVM	*88%*
MLP	*87%*
CNN	*98%*
CNN	*99% (1050 Data)*
LBPH	*92% (165)*
Dlib + SVC (Pretrained Model)	*98% (68 labels data),* *54% (5817 Labels)*
Custom DNN (Proposed Model)	*99.37% (68 label data) & 94% (5817 labels)*





CONCLUSION

Our customized DNN model has an excellent accuracy and recognition rate. Although the model performed well on both datasets, additional testing on a broader range of datasets with varying lighting conditions, poses, and occlusions too.

FUTURE WORK / REFERENCES

Future studies should focus on improving the model's resilience in challenging scenarios, such as recognizing partially obscured faces or faces in low-light conditions. Further exploration of different encoding methods is also recommended.